4 CHAPTER Centroids and Moment of Inertia

Q.1 The area moment of inertia of a square of size 1 unit about its diagonal is

(a) $\frac{1}{3}$ (b) $\frac{1}{4}$

(c) $\frac{1}{12}$ (d) $\frac{1}{6}$

Q.2 Assertion (A): Inertia force always acts through the centroid of the body and is directed opposite to the acceleration of the centroid.
Reason (R): It has always a tendency to retard the motion.
(a) both A and R are true and R is the correct explanation of A
(b) both A and R are true but R is not a correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

Q.3 Which of the following statement(s) is/are true?
1. Moment of inertia about any axis is always non zero.
2. Product of inertia of an area is always non zero.
3. Product of inertia is independent of coordinate system.
(a) Only 1 (b) 1 and 2
(c) 1 and 3 (d) 1, 2 and 3

Q.4 About principal axis
1. moment of inertia is maximum
2. product of inertia is zero
Which of the above statement(s) is/are correct?
(a) Only 1
(b) Only 2
(c) 1 and 2
(d) None of these

Q.5 Match List-I with List-II and select the correct answer using the codes given below:
List-I
A. Moment of inertia of a triangle about its base
B. Moment of inertia of a rectangle about its centroidal axis parallel to base
C. Moment of inertia of a rectangle about its base
D. Moment of inertia of a triangle about centroidal axis parallel to the base
List-II
1. $\frac{bh^3}{36}$ 2. $\frac{bh^3}{12}$
3. $\frac{bh^3}{3}$ 4. $\frac{bh^3}{24}$

Codes:

	A	B	C	D
(a)	4	2	3	1
(b)	2	2	3	1
(c)	3	4	1	2
(d)	3	3	2	4

Q.6 The polar moment of inertia of an ellipse having major axis length and minor axis length as 10 cm and 8 cm respectively is
(a) 410π
(b) 205π
(c) 3280π
(d) 1640π

Q.7 The centroid of a cross-section is
(a) geometric centre
(b) point about which the moment of inertia is zero
(c) point about which the moment of area is zero
(d) neutral axis always

Q.8 The product of the moment of inertia of a section is equal to zero if

(a) the section is essentially symmetrical about at least one axis

(b) the section is symmetrical about both the axis

(c) the axis pass through the centroid

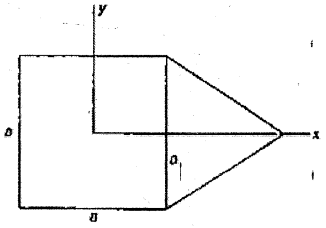
(d) the axis pass through the neutral layer

Q.9 Moment of inertia of a uniform circular disc about a diameter is I. Its moment of inertia about an axis perpendicular to its plane and passing through a point on its rim will be

(a) $5I$ (b) $3I$

(c) $6I$ (d) $4I$

Q.10 The product of moment of inertia of the area as shown in figure about x and y is



(a) Zero (b) $\frac{5a^4}{4}$

(c) $\frac{4}{5}a^4$ (d) $-\frac{5a^4}{4}$

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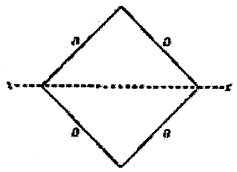
Answers Centroids and Moment of Inertia

1. (c) 2. (c) 3. (a) 4. (b) 5. (b) 6. (b) 7. (c) 8. (a) 9. (c) 10. (a)

Explanations Centroids and Moment of Inertia

1. (c)



$$I_{xx} = \frac{a^4}{12} = \frac{1}{12}$$

2. (c)

Inertia force always has a tendency to oppose the motion, not retard. If we want to retard a motion, then it will tend the body to accelerate.

4. (b)

Moment of inertia can be maximum or minimum about principal axis as the axis can be major principal axis or minor principal axis respectively. Principal axis is defined for zero product for inertia.

6. (b)

$a = 5$ cm

$b = 4$ cm

$$I_p = \frac{\pi \times 5 \times 4}{4}\left(5^2 + 4^2\right)$$

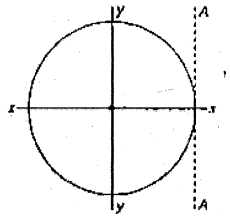
$$= 5\pi(25 + 16)$$

$$= 205\pi$$

8. (a)

Product of inertia is zero about principal axes and at least one of the principal axes is always symmetrical axis.

9. (c)



$$I_x = I_y = \frac{\pi D^4}{64} = I$$

$$I_z = I_x + I_y = 2I$$

Using parallel axes theorem

$$I_{AA} = I_z + Ar^2$$

$$= 2I + \frac{\pi D^2}{4} \times \left(\frac{D}{2}\right)^2$$

$$= 2I + 4I$$

$$= 6I$$

10. (a)

Axis x is symmetrical axis.

Product of moment of inertia is zero since one of the principal axes is symmetrical about x-axis.

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